Scenario Analysis Workshop

Public Health-related Impacts of Climate Change for California

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Scope of the Analysis

Predictions based on climate models

- Air pollution impacts -- emissions, global background, meteorology, formation
- Extreme temperatures and heat-related deaths

Literature reviews

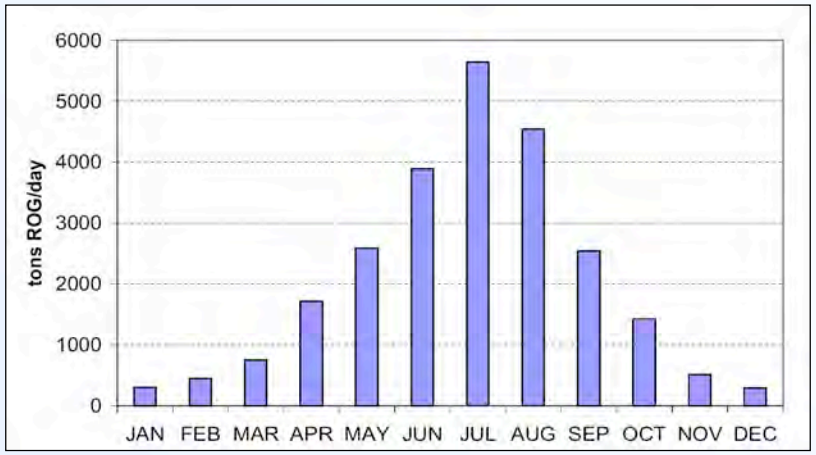
- Incidence of infectious diseases
- Impacts of increased wildfire frequency
- Environmental justice and other vulnerabilities
- Possible adaptation strategies

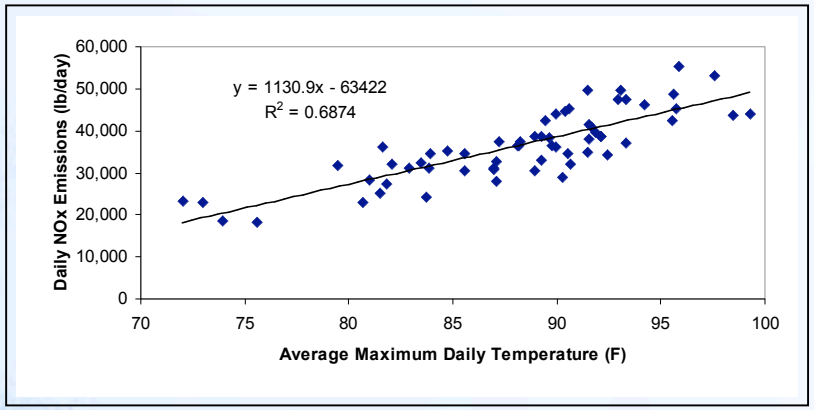
Climate Impacts on Emissions

- **Biogenic Hydrocarbons**
  - Majority of biogenic emissions are produced during the ozone season (May through October)
  - GCM for 2070-2099 for a doubled CO_2 predicted increase of BVOC emissions by a factor of 3 for some vegetation types (Constable, et al. 1999)

- **Power Plants**
  - Using CEC's trend line for NO_X, ~ 3% linear increase in NO_X per degree temp (^oF) increase
  - Overall net effect on future emissions, taking into account future emissions controls changes in power plant and air conditioning technologies, and population changes, is unclear

Current –Statewide Biogenic Emissions



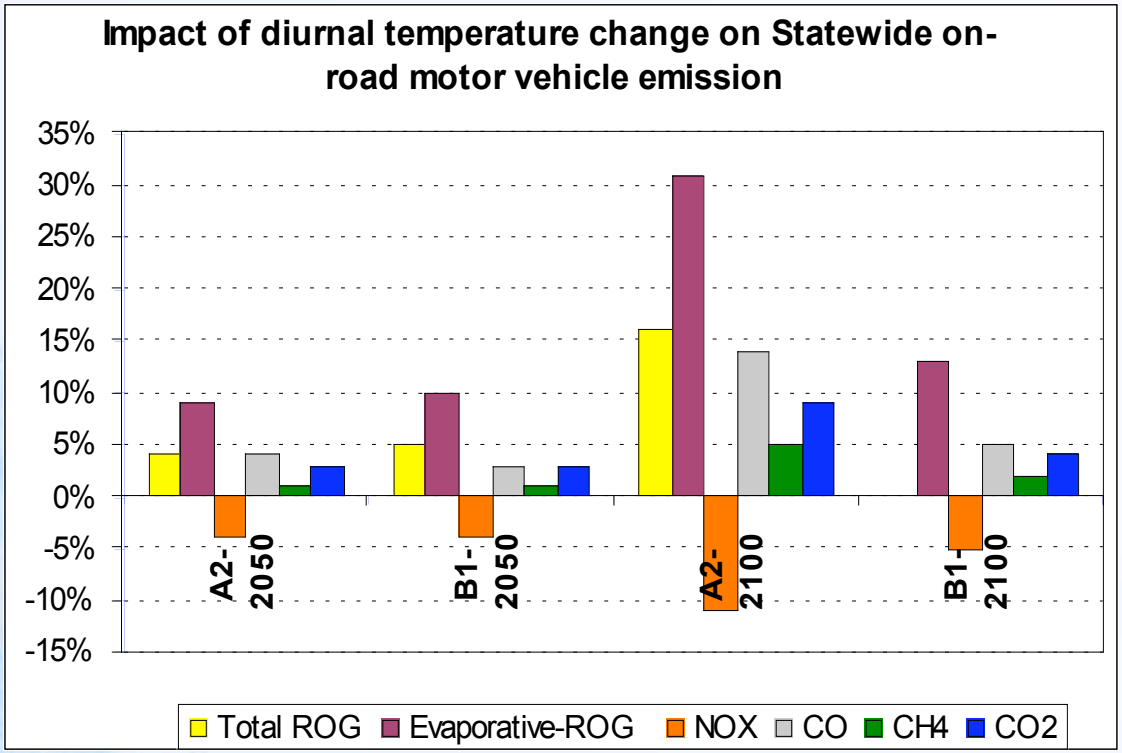


Power plants NO_X emissions vs. daily maximum temperature summer (July-September) at Sacramento, San Jose, Fresno and Los Angeles

Climate Impacts on Emissions

(Cont.)

- Motor Vehicles
  - EMFAC model output data for August for medium (A2) and low (B1) GHGs scenarios
  - Increases in population, or changes in vehicle technology and vehicle activity not considered
  - Total and evaporative ROG, CO, CH_4, and CO_2 increased, ranging from 1 to 31%
  - NO_X decreased between 3 and 11%
  - The EMFAC runs assumed constant relative humidity. Due to the handing of humidity in EMFAC this could impact NO_X estimates but the overall impact is unknown

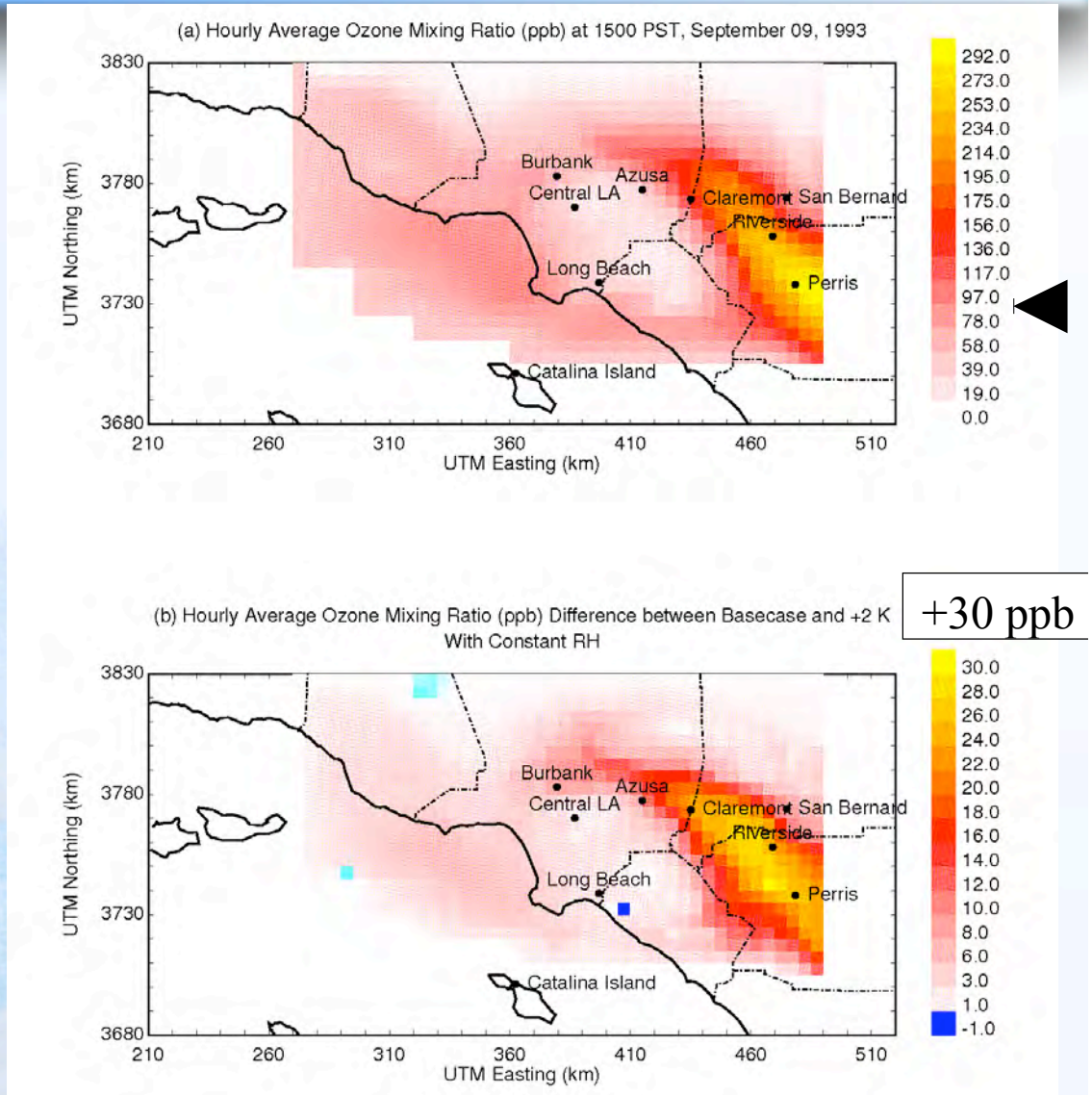


Ozone Response to Climate

Basecase Episode Features:
September 9, 1993.
Elevated temperature inversion
Warm nights, hot days.

Sensitivity Study:
1. Increase temperature by +2C (+3.6F).
2. Maintain constant RH.

Results
+30ppb Increase in Ozone



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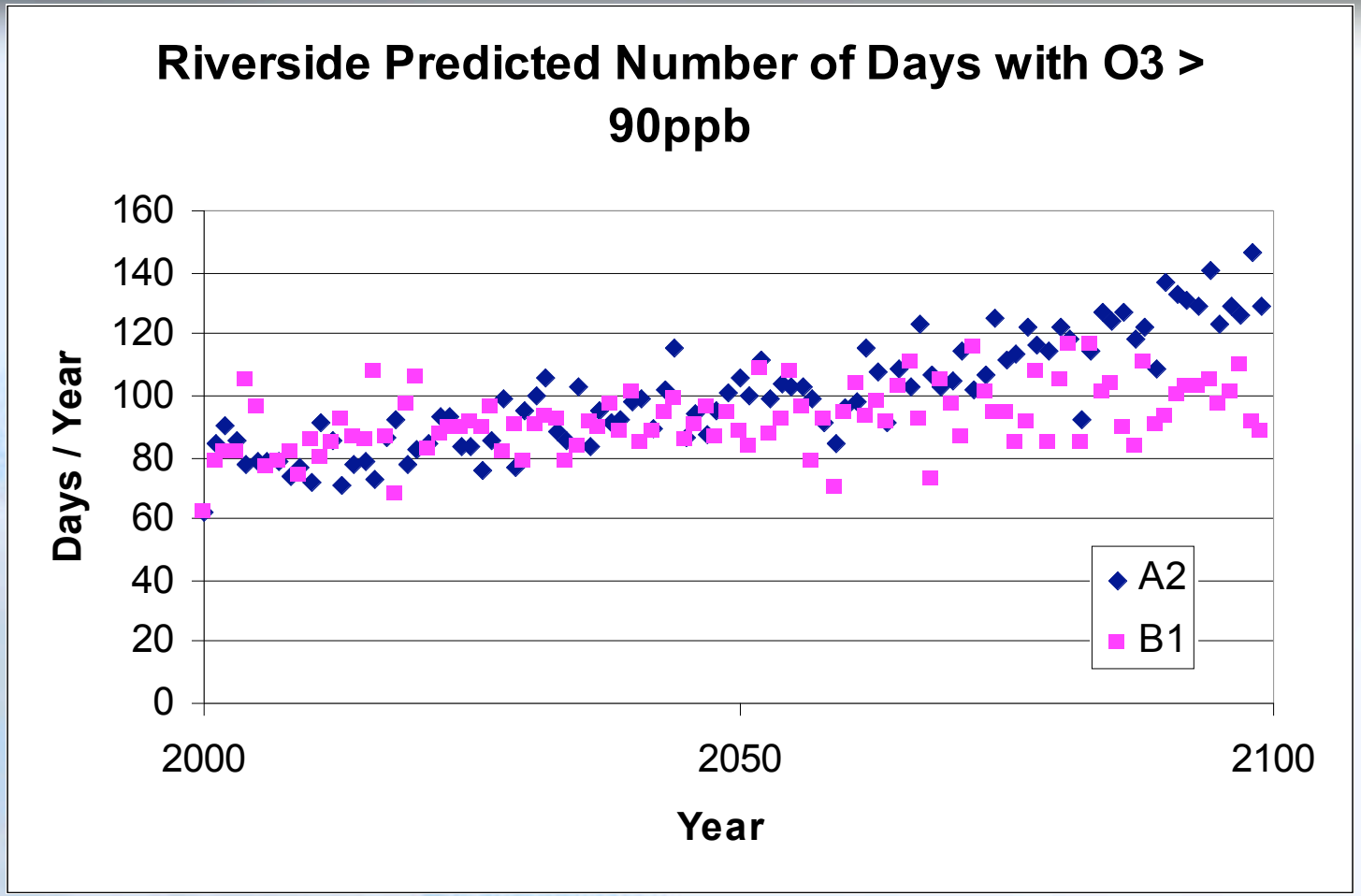
Future Ozone Projections



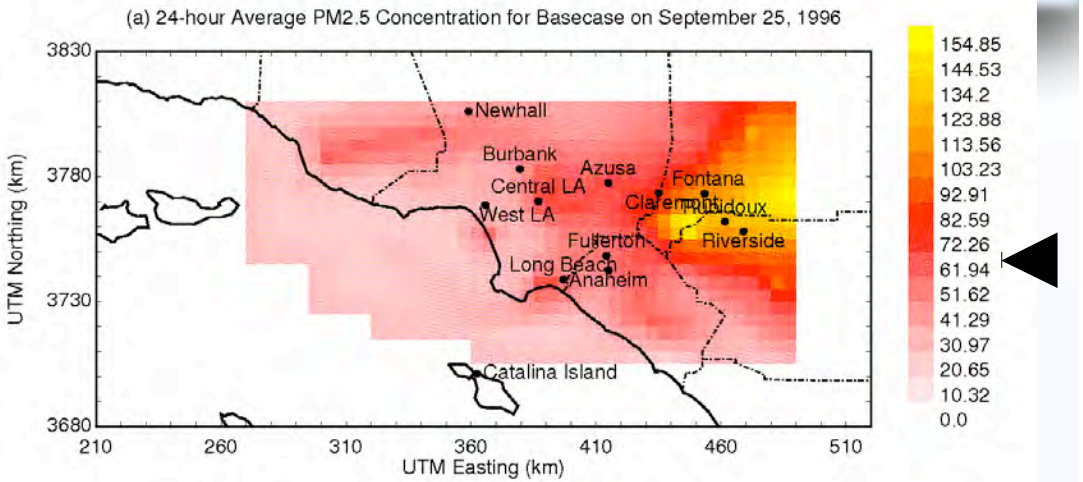
Statistical correlation between T850 and ozone projected to the future using GFDL

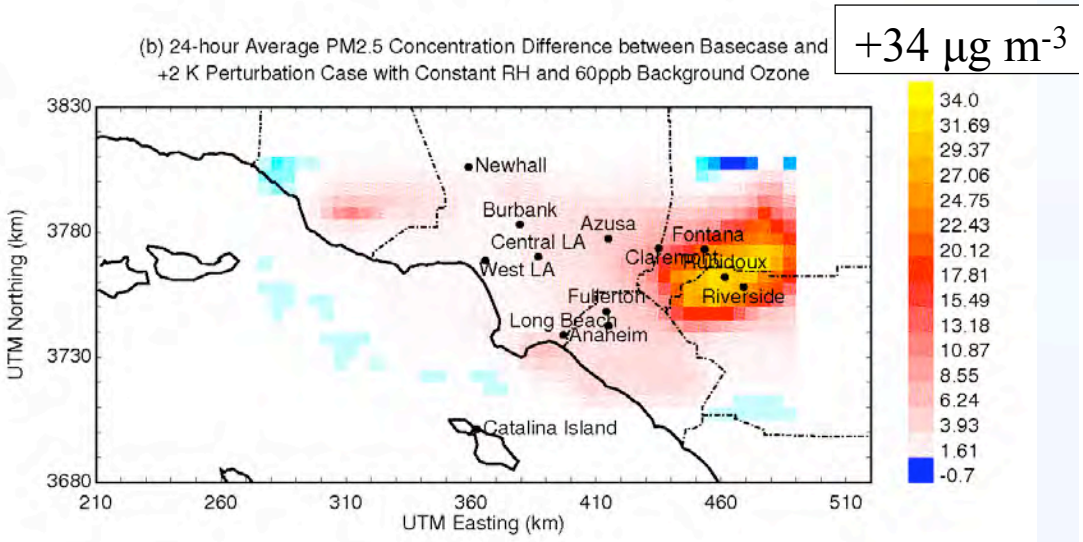
PM Response to Climate

Basecase Episode Features:
September 25, 1996.
Elevated temperature inversion
Cool nights, warm days.

Sensitivity Study:
1. Increase background Ozone to 60ppb.
2. Increase temperature by +2C (+3.6F).
3. Maintain constant RH.

Results:
+34 µg m^{-3} increase in PM2.5





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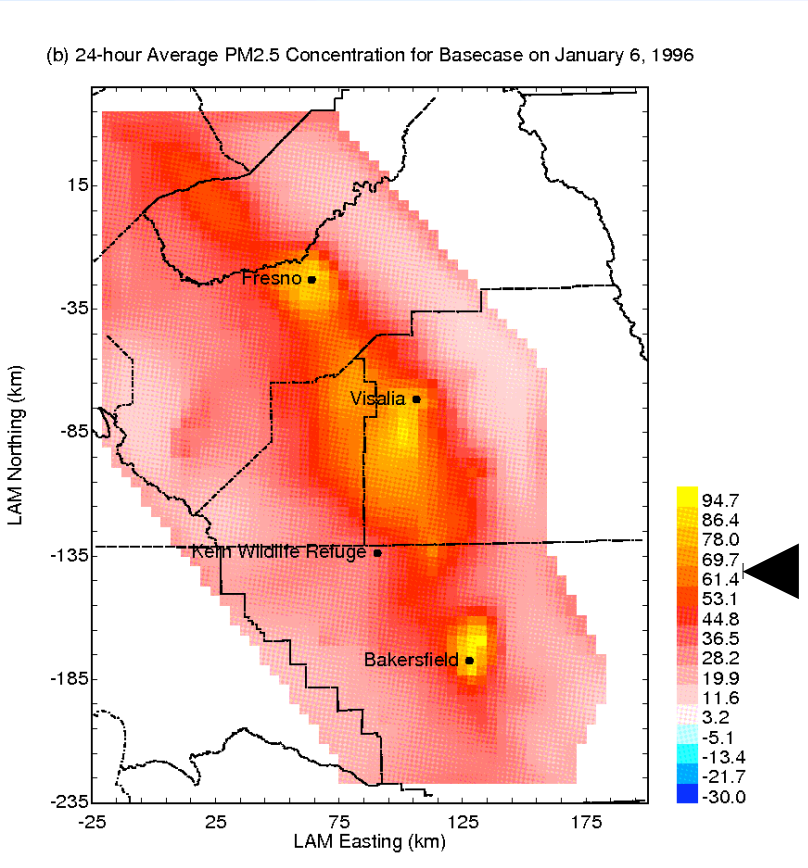
PM Response to Climate

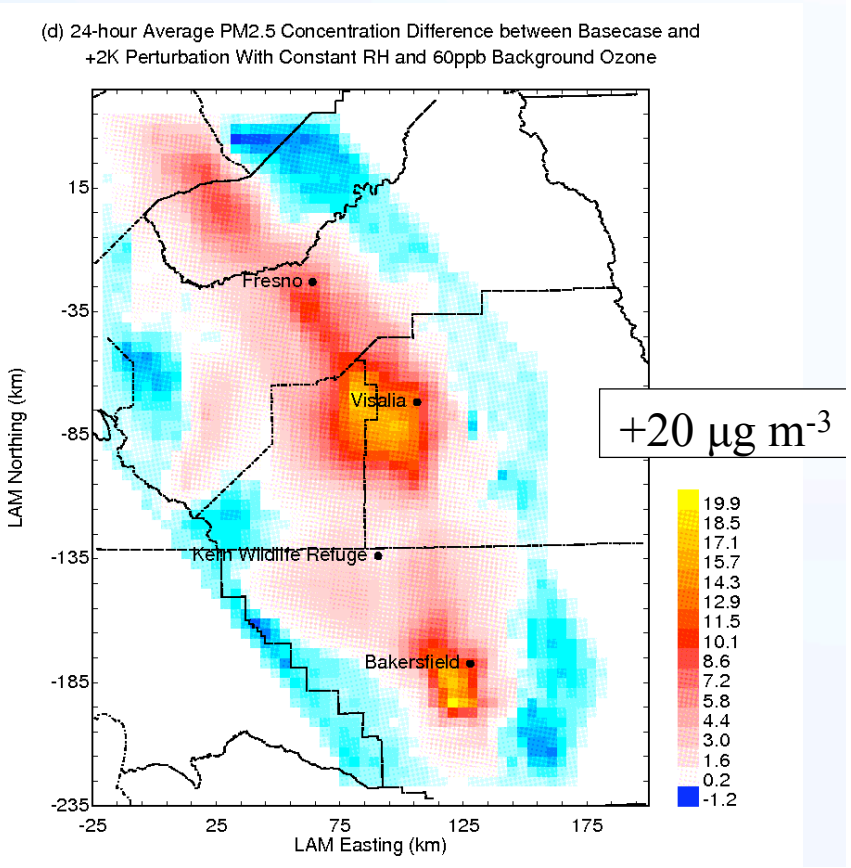
Basecase Episode Features:

January 6, 1996.
Elevated temperature inversion
Cold nights, cool days.

Sensitivity study:

1. Increase background Ozone to 60ppb.
2. Increase temperature by +2C (+3.6F).
3. Maintain constant RH.





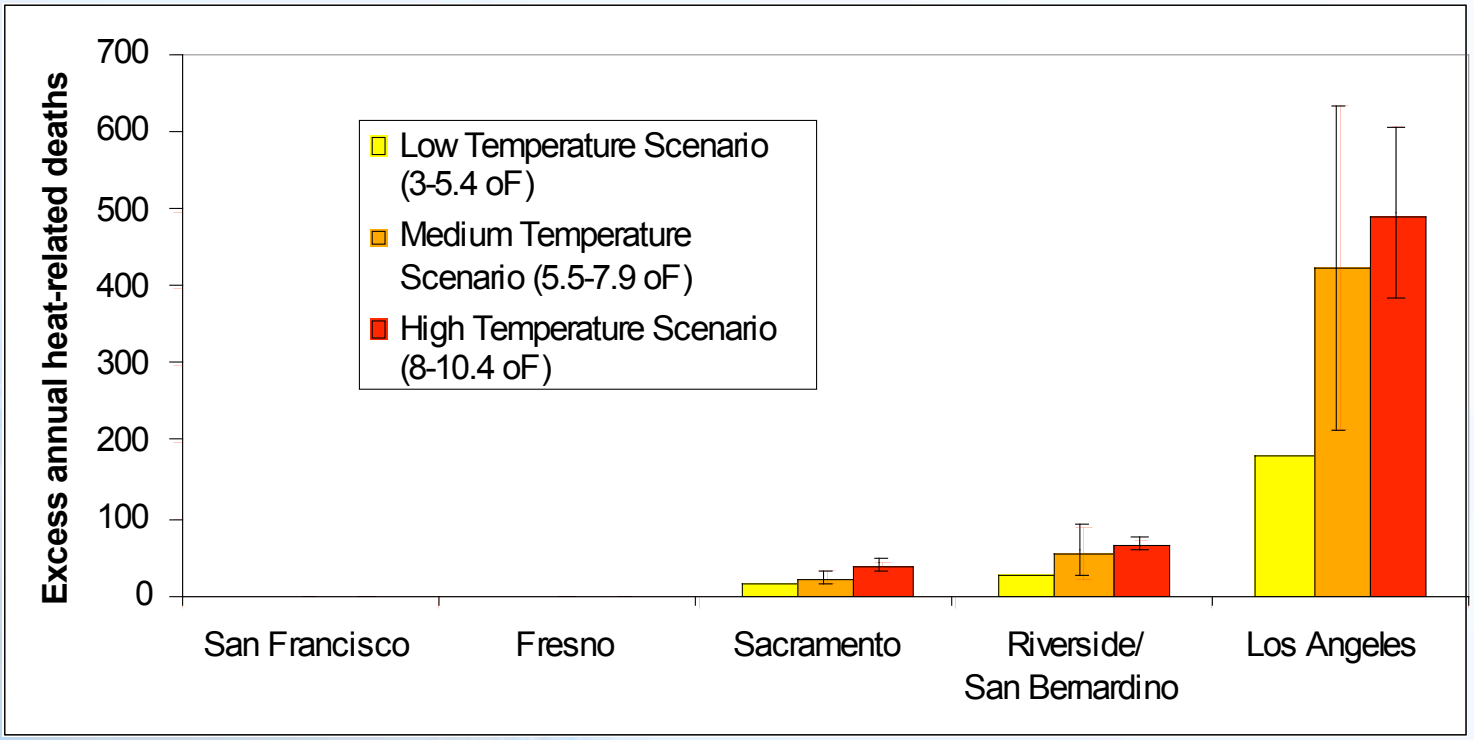
Estimated Health Impacts*

Per Year

- 9,000 premature deaths
- 9,500 hospitalizations
- 340,000 asthma attacks
- 4,700,000 school absences
- 2,800,000 lost work days
- $70 billion aggregate cost
- $4 health benefit for every $1 spent on control

*Estimated impacts of not attaining California's ambient ozone and PM standards for the year 2000. Values contain at least a factor of two uncertainty.

Heat Wave Death Projections



Projected heat-related mortality for 2070-2099 relative to 1970-2099

Other Climate-related Impacts

- Infectious Diseases
  - water, vector, rodent and food-borne diseases
  - affected by temperature and rainfall, but little or no information on climate change impacts
- Wildfire Health Effects
  - increased respiratory symptoms and premature death
  - very dependent on local conditions

Environmental Justice

- Air Pollution
  - elderly, pre-existing disease, and children most vulnerable
  - living by freeways and other emissions sources (disproportionately low-income) get highest exposure
- Heat-related Death
  - low-income elderly most at risk
- Asthma
  - triggered by dust mites, molds, pollens
  - higher rates for African-Americans
  - climate impacts unclear

Possible Adaptation Strategies

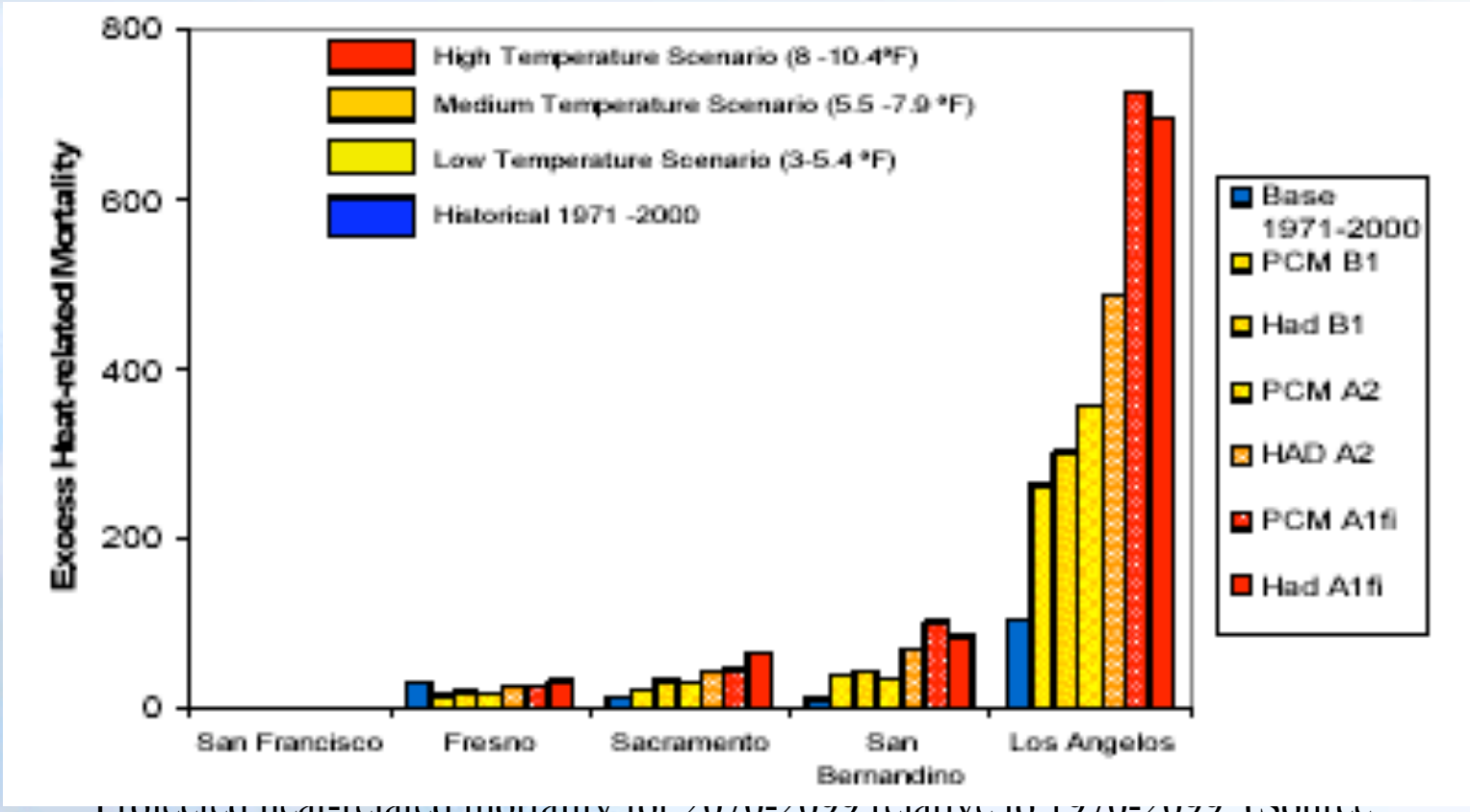
- Changes in social, behavior, and activity patterns
- Increased use of air conditioning
- Land use patterns
- Public health education programs
- Heat and air quality emergency action plans

Peer Review Comments

- More uncertainty analyses for heat-related deaths
- Add section on infant and children vulnerabilities
- Discuss impacts of catastrophic flooding and other weather events, potential disruption of agriculture, etc.
- Include economic costs of adaptation
- Expand research needs section

Extra Slides

Heat Wave Death Projections



Projected heat-related mortality for 2070-2099 relative to 1970-2099. (Source: Drechsler et al., in review)

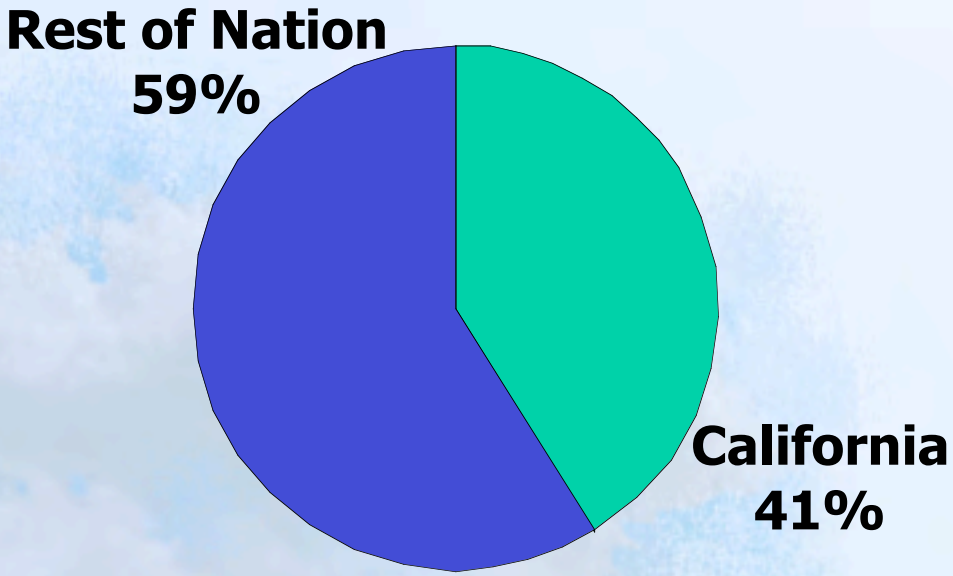
Unique, Adverse Meteorology

Onshore circulation pattern, high temperatures, stagnant air masses, and mountain ranges that trap pollutants lead to ...

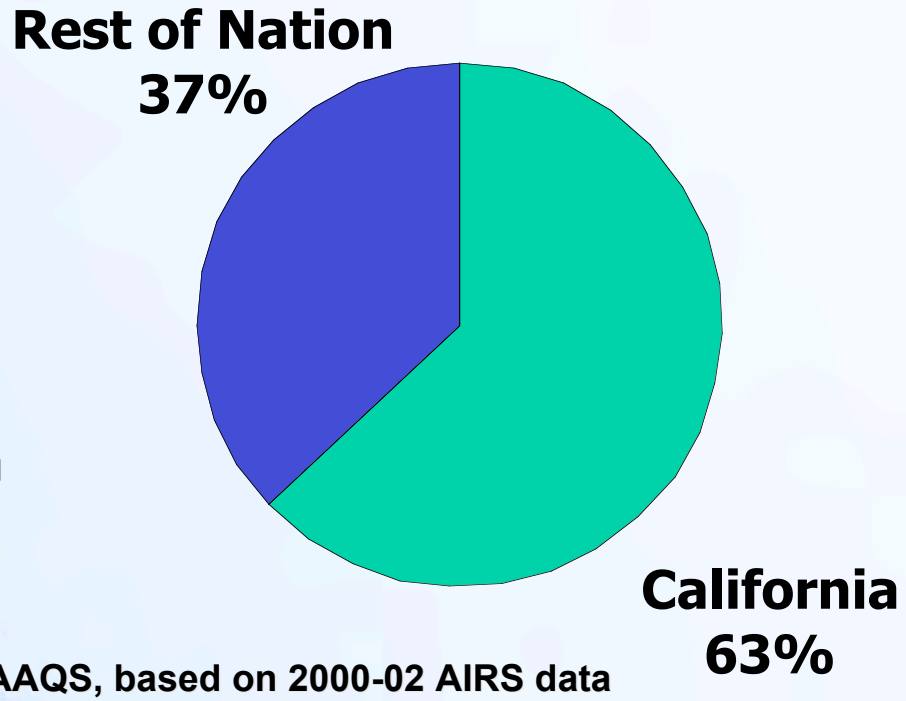
	Population (million)	Carrying Capacity (tpd)	Capacity ($VOC+NO_X$) (lb/person/yr)
South Coast	16.9	840	36
San Joaquin Valley	4.1	630	69
Houston	5.5	1360	181

Disproportionate Exposure

8-Hour Ozone
(NAAQS = 0.08 ppm)



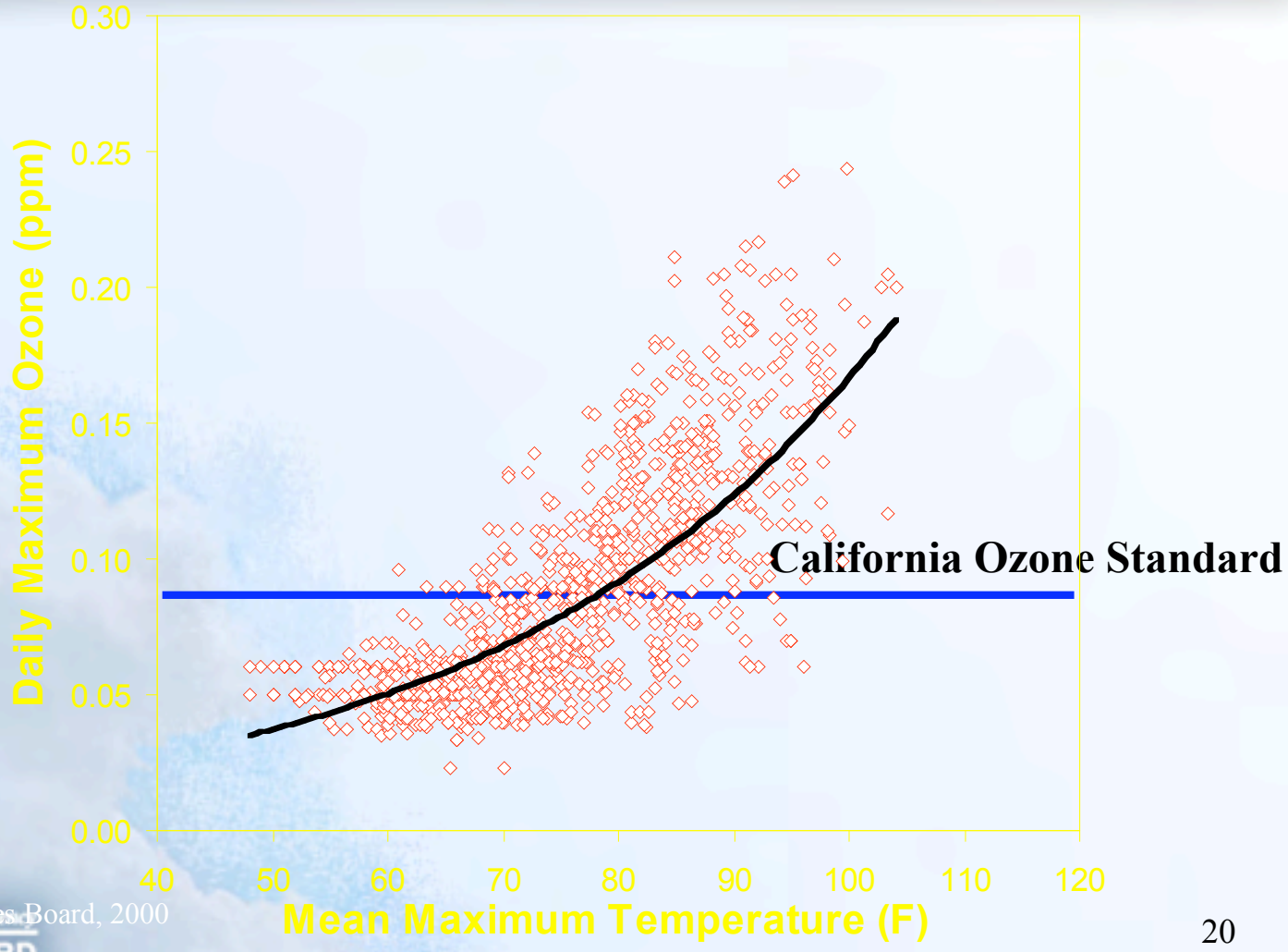
Annual PM2.5
(NAAQS = 15 µg/m^3)



Population-weighted and minus NAAQS, based on 2000-02 AIRS data

Hotter Days Lead To Higher Emissions And More Ozone

South Coast Air Basin Ozone Peaks (1996-1999)



Source: Air Resources Board, 2000

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